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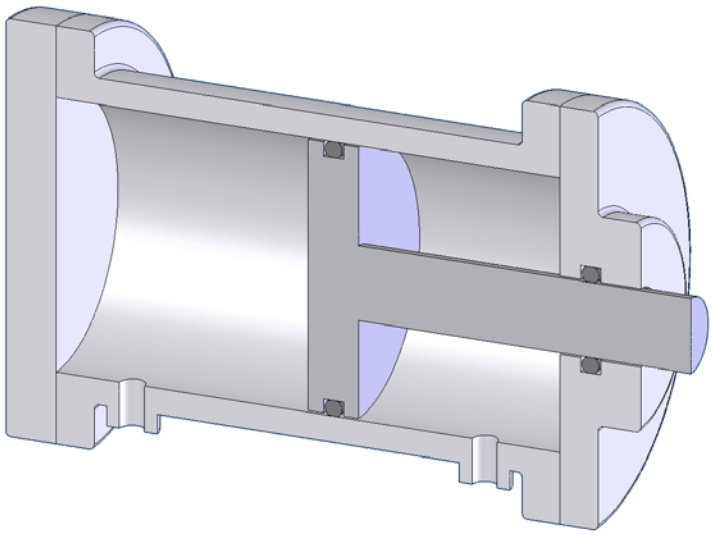
Application Data

Seal Gland Design



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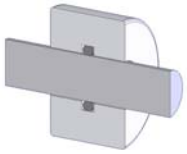


DESIGN DIMENSIONS FOR O-RING INSTALATION

O-Rings are normally used as seals in several ways, and dimensions of the groove or gland will also vary with the cross section of the ring, the type of operation, and the amount of the pressure used in the system. These dimensions will also be different if the O-Ring is sealing a liquid which has a low volume swell on the ring (0-15% Design Chart 1& 3) or if it is sealing a liquid which has a high volume swell on the ring (15-25% Design Chart 2 & 4). It has not been practical to attempt to seal liquids, which will swell the O-Ring more than 25%, in most cases, since the rings will lose most of their desirable physical properties with such a high swell.

STATIC SEALS (Design Charts 1, 2, 3, & 4)

In a static seal, where the O-Ring does not move and is used simply for containing pressure or maintaining a vacuum, the ring may be compressed AXIALLY or parallel to a line drawn through the center or axis of the ring. In this case, you will use the dimensions under AXIAL opposite the cross section of the ring you desire.

Although the depth and width of the groove will remain the same for all Axial static seals, the I.D. and O.D. of the groove will vary depending on whether you are sealing against internal pressure or external pressure (a vacuum in the vessel being sealed.).

In the case of internal pressure, the O.D. of the groove should be the same as the O.D. of the ring, plus the normal tolerance for that size ring.

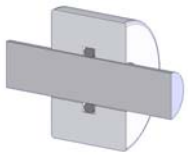
In the case of external pressure (i.e., a vacuum in the vessel being sealed), the I.D. of the groove should be the same as the I.D. of the ring being used, plus the normal tolerance range for that size ring.

A static seal ring may also be compressed RADIALLY; that is, being compressed between the internal diameter (I.D.) and overall diameter (O.D.). In the case, you will use the dimensions under RADIAL opposite the appropriate cross section column for the ring you wish to use.

DYNAMIC SEALS (Design Charts 1, 2, 3, 4 & 5)

Dynamic or moving seals basically fall into two classes; reciprocating (as in the case fo the piston and a cylinder), or rotating (as in the case of a shaft rotating in a housing). Reciprocating design data will be found in Charts 1, 2, 3 & 4. Rotating design data will be found in Chart 5.

Reciprocating seals may be designed so as to permit or prevent rolling of the ring within the groove. When the ring is allowed to roll within the groove, the breakaway force necessary to move the piston is usually lower; but some sacrifice must be made in the pressure, limitations of the seal and also in the life of the seal. This is caused by the constant flex of the O-Ring with each stroke of the piston.



DIAMETRAL CLEARANCE (Design Chart 6)

Under the dynamic section, you will also find a section on diametrical clearance. This calls out the maximum clearance between a piston and cylinder for pressure to 1500 psi, using a 70-durometer compound (low swell fluid) or a 60-durometer compound (in a high swell fluid). If higher pressures are required, a different durometer O-Ring may be used, as shown in Design Chart 6; or back-up rings may be used (see next heading). Design Chart 6 gives an elaboration of the diametric clearance for various durometers and various pressures. Adherence to these clearances will largely prevent extrusion of the O-Ring between the piston and cylinder or shaft and groove, up to the 5,000 psi using a 90-durometer compound.

BACK-UP RINGS

When you have a tendency for O-Rings to extrude between the sealing areas under pressure, there are three choices available to minimize this:

1. A harder O-Ring material may be used.
2. Clearances may be reduced to a minimum.
3. Back-up rings may be used.

O-Ring design Charts 1 and 2 show the groove widths necessary to accommodate the thickness of the back-up rings. PAI's Kurv-Bak™ or Teflon® back-up rings may be used. Good practice is to use a back-up ring on either side of the O-Ring, even though the pressure on the ring may be from one side only. The only time you will design for a back-up ring on one side is when there is not enough space for two rings.

ROTATING SEALS (Design Chart 5)

Rotating seals should be limited to shafts having the following maximum rotational speed:

Shaft Diameter	Feet/Min
.125 - .280	350
.281 - .625	400
.626 - .687	450
.688 - 1.250	600

In rotating shaft seals, a higher durometer (80-90) compound is usually used. Preferably, it should have excellent abrasion resistance and quite often is internally lubricated with graphite or molybdenum disulfide to give maximum protection if run dry.

To find the groove dimensions in a rotating seal, use Design Chart 5. Find the shaft size in the second column. The groove root diameter and width will be found under their respective columns. The Precision Associates O-Ring size will be found in the first column next to shaft diameter.

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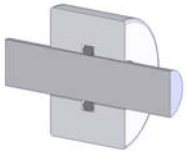
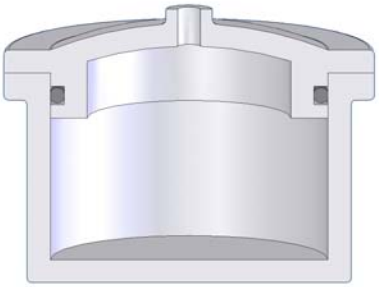


STATIC SEAL: EXAMPLE RADIAL SEAL

It is desired to seal a pressure vessel filled with air at 200 psi. The I.D. of the vessel at the sealing lip is 3.000" and the thickness of the cover at the groove point is .250".



First: Pick a ring series that has a cross section, which can be cut into the cover without weakening the cover at this point. (100 series)

Second: Find an O-Ring in this series that has an O.D. closest to 3.000" (1-149-O.D. 3.006).

Third: Check the swell characteristics of air, with possible oil traces in it. (Low swell – 0-15%)

Fourth: In the normal swell Design Chart 1, find the cross section column for the 100 series rings (.103± .003).

Fifth: In this column, opposite the RADIAL section, find the groove depth (.083-.003) and the groove width (.125± .005).

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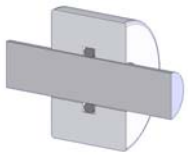
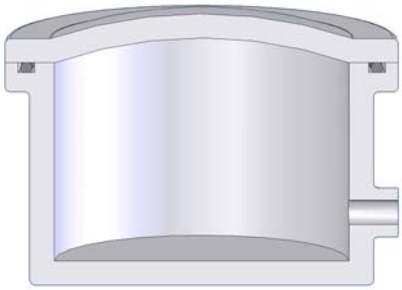


STATIC SEAL- EXAMPLE: AXIAL SEAL

It is desired to seal a pressure vessel filled with hydraulic oil at 1200 psi. The I.D. of the vessel is 4 inches, and the flange is 1 inch wider and 3/8" thick (see drawing).



First: Find the O-Ring sizes that will fit within the sealing area. (1-244, 1-156)

Second: Pick the series O-ring desired, based on the thickness of the flange available to cut the groove depth desired. (1-244)

Third: Check the swell characteristics of the fluid on the rubber to determine whether the normal or high swell chart will be used for dimensions of the O-Rng groove. (In this case 0-15% or normal swell Chart 1.)

Fourth: Since this is an internal pressure application, the O.D. of the groove should be the O.D. of the ring (4.512) plus the tolerance (.015) or 4.527 inches.

Fifth: Since this is an axial squeeze, look in the AXIAL section, Design Chart #1, under the cross section of the ring (.139). The groove depth will be .110"-.008" and the width will be .185" ± .005.

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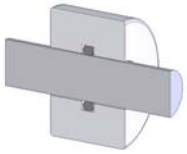
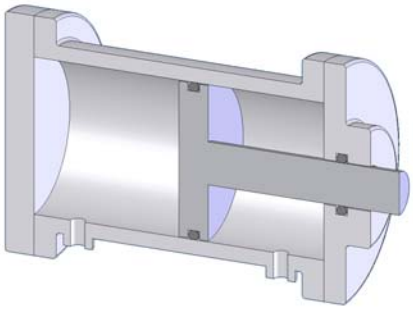


DYNAMIC SEAL: RECIPROCATING, Low Pressure

A Piston moves back and forth in a 1.000" cylinder to pump acetone at a pressure of 200 psi, maximum. An O-Ring seal is required for this piston.



First: Find ring sizes whose O.D. is close to 1.000" (1-117,1-210).

Second: Check the swell characteristics of the liquid being pumped (acetone swells most rubbers but does not attack EPDM rubber, so an EPDM ring could be used with normal swell – table 1).

Third: Opposite the dynamic section under the cross section of the 100 series (.103± .003), find the depth of the groove (.090-.003) and the width of the groove (.120± .005). If it were desired that the ring roll in the groove, the width would be .145± .005.

DYNAMIC SEAL: RECIPROCATING, High Pressure

A piston seal is desired for a high pressure piston at 3,000 psi using hydraulic oil. Piston diameter is .875".

First: Find a ring size with an O.D. approximately .875" (1-115 with an O.D. of .880).

Second: Determine whether the swell characteristics will fall into the normal (0-15%) or high (15-25%) range (normal range Design Chart 31).

Third: Find under the cross section column (.103"±.003") opposite dynamic section, Design Chart #1, the groove depth (.090"-.003"),

Fourth: Since the pressure range is over the 1500 psi maximum, 2 back-up rings will be required – one on either side of the O-Ring. Under the column MS 28774 dash 110-149 the width of the groove, with 2 rings, will be .246". The rings to use will have the number MS 28774-115.

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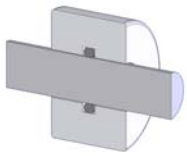
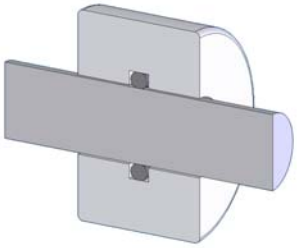


DYNAMIC SEAL: ROTATING SEAL

It is desired to seal a mixer shaft with a rotor extending into the vessel through a housing seal and bearing combination and driven at 450 linear feet per minute. The shaft diameter is 1.000 inches. The material being mixed is a blend of oil and detergents.



First: In Design Chart 5, find in the second column the shaft size (1-inch).

Second: Under the Groove root Diameter, find the root diameter (1.265).

Third: Under the groove width column, find the groove width (.157).

Fourth: Under the radial clearance column, find the clearance of the shaft in the housing (.0015-.0012).

Fifth: Under the bearing I.D. tolerance, find the clearance of the shaft in the bearing (-.0000+.0012).

Sixth: On the extreme left column, find the PAI O-Ring size (1-215).

LUBRICATION OF O-RINGS AND PARTS FOR EASE IN ASSEMBLY

In assembling O-Rings and components into a unit part, it is quite often necessary to lubricate the o-ring or seal in order to facilitate easy assembly. This is usually a temporary lubricant, since the liquid being sealed will generally provide lubrication when in operation. If the operating fluid does not provide sufficient lubricity, or if the seal is operating in a gas or a vacuum, it may be necessary to pre-lubricate the assembly for lower friction during operation.

Precision Associates is able to provide your seals pre-lubricated, or we can recommend lubricants for application at assembly. Contact Precision Associates' Customer Service for lubrication recommendations for your application.

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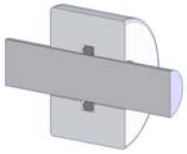

DESIGN CHART #1 - INDUSTRIAL O-RINGS - NORMAL SWELL (0 TO 15%)

O-RING CROSS SECTION	.040	.050	.060	.070	.103	.139	.176	.210	.275
PAI Size Number Range	1-001 and 40-70	1-002	1-003	1-004 thru 1-055	1-108 thru 1-178	1-202 thru 1-284	1-514 thru 1-572	1-312 thru 1-395	1-400 thru 1-476
O-Ring ID Size Range	1/32" and 1/16"	3/64"	1/16"	5/64" thru 6-1/2"	1/4" thru 9-3/4"	1/4" thru 18"	1" thru 4-7/8"	5/8" thru 26"	1-7/8" thru 27"
AXIAL									
Squeeze (min.)	.010	.012	.014	.017	.020	.025	.027	.030	.039
Gland Depth (max.)	.027 -.002	.035 - .002	.043 - .002	.050 - .004	.080 - .006	.110 - .008	.147 ± .003	.175 - .010	.230 - .010
Groove Width (wall to wall)	.063 ± .002	.073 ± .003	.084 ± .003	.095 ± .003	.145 ± .003	.185 ± .005	.235 ± .005	.285 ± .005	.375 ± .005
RADIAL									
Squeeze (min.) Per Side	.007	.010	.012	.015	.017	.020	.022	.025	.035
Gland Depth (max.)	.030 -.001	.037 -.001	.045 -.001	.052 -.002	.083 -.003	.115 -.004	.150 - .004	.180 -.005	.234 -.006
Groove Width (Wall to Wall)	.056 ± .002	.064 ± .003	.075 ± .003	.090 ± .003	.125 ± .003	.170 ± .005	.210 ±.005	.240 ± .005	.315 ± .005
DYNAMIC									
Squeeze (min.) Per Side	.005	.006	.008	.010	.010	.012	.015	.017	.029
Gland Depth (max.)	.032 - 001	.041 - .001	.049 - .001	.057 - .002	.090 - .003	.123 - .004	.156	.188 - .005	.240 - .006
Groove Width									
With Roll	.063 ± .003	.073 ± .003	.084 ± .003	.095 ± .003	.145 ± .005	.185 ± .005	.235 ± .005	.285 ± .005	.375 ± .005
No Roll	.056 ± .003	.064 ± .003	.075 ± .003	.090 ± .003	.120 ± .005	.160 ± .005	.210 ± .005	.235 ± .005	.310 ± .005
One Back-up				.149 ± .003	.183 ± .003	.225 ± .003		.334 ± .005	.440 ± .005
Two Back-ups				.207 ± .003	.245 ± .003	.304 ± .003		.424 ± .005	.579 ± .005
DIAMETRAL CLEARANCE*									
500 PSI	.005	.006	.007	.008	.010	.012	.013	.014	.016
1500 PSI	.0025	.003	.0035	.004	.005	.006	.007	.007	.008
R Radius (max.)	.005	.008	.012	.015	.020	.030	.040	.050	.060
Eccentricity (max.)	.001	.001	.001	.002	.002	.003	.004	.004	.005

* These maximum diametral clearances based on 70 Durometer compound.
If harder compound is used see chart 6 for proper maximum clearance.

The Gland dimensions provided are only intended to be a starting point for your design. We recommend that you test each application to meet your requirements.

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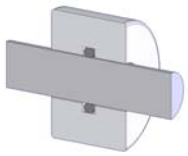

DESIGN CHART #2 - INDUSTRIAL O-RINGS-HIGH SWELL (15 TO 25%)

O-RING CROSS SECTION	.040	.050	.060	.070	.103	.139	.176	.210	.275
PAI Size Number Range	1-001 and 40-70	1-002	1-003	1-004 thru 1-055	1-108 thru 1-178	1-202 thru 1-284	1-514 thru 1-572	1-312 thru 1-395	1-400 thru 1-476
O-Ring ID Size Range	1/32" and 1/16"	3/64"	1/16"	3/32" thru 6-1/2"	1/4" thru 9-3/4"	1/4" thru 18"	1" thru 4-7/8"	5/8" thru 26"	1-7/8" thru 27"
AXIAL									
Squeeze (min.)	.012	.015	.017	.020	.024	.030	.034	.043	.056
Gland Depth (max.)	.025 -.002	.032 -.002	.040 -.002	.047 -.002	.076 -.003	.105 -.004	.139 -.004	.162 -.005	.213 -.006
Groove Width (wall to wall)	.065	.076	.088	.108	.162	.215	.267	.317	.418
RADIAL									
Squeeze (min.) Per Side	.010	.012	.014	.016	.020	.025	.027	.030	.040
Gland Depth (max.)	.027 -.001	.035 -.001	.043 -.001	.051 -.002	.080 -.003	.110 -.004	.146 -.004	.175 -.005	.229 -.006
Groove Width (Wall to Wall)	.065	.076	.088	.108	.162	.215	.273	.317	.418
DYNAMIC									
Squeeze (min.) Per Side	.008	.010	.012	.014	.017	.020	.023	.025	.035
Gland Depth (max.)	.029 -.001	.037 -.001	.045 -.001	.053 -.002	.083 -.002	.115 -.003	.149 -.003	.180 -.003	.234 -.004
Groove Width	.065	.076	.088	.103	.154	.204	.271	.305	.405
DIAMETRAL CLEARANCE*									
500 PSI	.004	.005	.006	.007	009	.011	.011	.012	.014
1500 PSI	.002	.0025	.003	.004	.005	.006	.006	.007	.008
R Radius (max.)	.005	.008	.012	.015	.020	.030	.035	.040	.050
Eccentricity (max.)	.001	.001	.001	.002	.003	.004	.004	.005	.006

* These maximum diametral clearances based on 60 Durometer compound.
If harder compound is used see chart 6 for proper maximum clearance.

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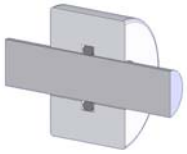

DESIGN CHART #3 - 900 SERIES O-RINGS - NORMAL SWELL (0 TO 15%)

O-RING CROSS SECTION	.056	.064	.072	.078	.082	.087	.097	.116	.118
PAI Size Number Range	1-901	1-902 and 1-903	1-904 and 1-905	1-906	1-907	1-908	1-909 and 1-910	1-911 thru 1-918	1-920 thru 1-932
O-Ring ID Size Range	.185	.239 .301	.351 .451	.468	.530	.644	.706 .755	.863 1.355	1.475 2.337
AXIAL									
Squeeze (min.)	.012	.014	.016	.017	.018	.019	.020	.022	.022
Gland Depth (max.)	.040 -.002	.046 -.002	.051 -.004	.058 -.004	.065 -.005	.072 -.005	.080 -.006	.090 -.006	.090 -.006
Groove Width (wall to wall)	.079 ±.003	.088 ±.003	.095 ±.003	.107 ±.003	.120 ±.003	.130 ±.004	.145 ±.005	.158 ±.005	.158 ±.005
RADIAL									
Squeeze (min.) Per Side	.011	.013	.014	.014	.015	.016	.017	.018	.018
Gland Depth (max.)	.042 -.001	.047 -.001	.053 -.001	.063 -.001	.070 -.001	.078 -.002	.083 -.003	.094 -.003	.094 -.003
Groove Width (Wall to Wall)	.070 ±.003	.078 ±.003	.090 ±.003	.098 ±.003	.107 ±.005	.183 ±.005	.125 ±.006	.141 ±.006	.141 ±.006
DYNAMIC									
Squeeze (min.) Per Side	.007	.008	.009	.009	.009	.010	.010	.011	.011
Gland Depth (max.)	.046 -.001	.052 -.001	.058 -.001	.065 -.001	.068 -.001	.072 -.002	.083 -.003	.094 -.003	.094 -.003
Groove Width									
With Roll	.079 ±.003	.088 ±.003	.095 ±.003	.105 ±.003	.111 ±.004	.117 ±.004	.145 ±.005	.158 ±.005	.160 ±.005
No Roll	.068 ±.003	.078 ±.003	.090 ±.003	.098 ±.003	.139 ±.004	.109±.004	.120 ±.005	.158 ±.005	.160 ±.005
DIAMETRAL CLEARANCE*									
500 PSI	.006	.007	.008	.008	.009	.009	.010	.011	.011
1500 PSI	.003	.004	.004	.004	.004	.004	.005	.005	.005
R Radius (max.)	.010	.013	.015	.015	.015	.018	.020	.022	.022
Eccentricity (max.)	.001	.001	.001	.001	.001	.001	.002	.002	.002

* These maximum diametral clearances based on 70 Durometer compound.
If harder compound is used see chart 6 for proper maximum clearance.

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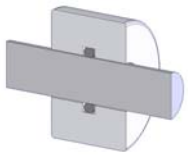

DESIGN CHART #4 - 900 SERIES O-RINGS - HIGH SWELL (15 TO 25%)

O-RING CROSS SECTION	.056	.064	.072	.078	.082	.087	.097	.116	.118
PAI Size Number Range	1-901	1-902 and 1-903	1-904 and 1-905	1-906	1-907	1-908	1-909 and 1-910	1-911 thru 1-918	1-920 thru 1-932
O-Ring ID Size Range	.185	.239 .301	.351 .451	.468	.530	.644	.706 .755	.863 1.355	1.475 2.337
AXIAL									
Squeeze (min.)	.016	.016	.020	.021	.021	.022	.023	.025	.027
Gland Depth (max.)	.039 -.002	.042 -.002	.048 -.002	.053 -.002	.056 -.002	.061 -.002	.072 -.003	.088 -.003	.090 -.003
Groove Width (wall to wall)	.084	.092	.110	.121	.129	.138	.157	.186	.188
RADIAL									
Squeeze (min.) Per Side	.014	.015	.017	.018	.018	.018	.019	.0121	.022
Gland Depth (max.)	.042 -.001	.048 -.001	.054 -.001	.059 -.001	.062 -.001	.066 -.002	.078 -.003	.098 -.003	.100 -.003
Groove Width (Wall to Wall)	.084	.092	.110	.119	.125	.133	.156	.179	.189
DYNAMIC									
Squeeze (min.) Per Side	.011	.012	.015	.016	.016	.016	.016	.017	.018
Gland Depth (max.)	.042 -.001	.048 -.001	.054 -.001	.059 -.001	.062 -.001	.066 -.002	.078 -.003	.098 -.003	.100 -.003
Groove Width	.065	.076	.088	.103	.154	.204	.305	.405	.405
DIAMETRAL CLEARANCE*									
500 PSI	.005	.006	.007	.007	.007	.007	.008	.010	.010
1500 PSI	.002	.003	.004	.004	.004	.004	.004	.005	.005
R Radius (max.)	.010	.013	.015	.015	.015	.020	.020	.020	.020
Eccentricity (max.)	.001	.001	.002	.002	.002	.002	.002	.002	.003

* These maximum diametral clearances based on 60 Durometer compound.
If harder compound is used see chart 6 for proper maximum clearance.

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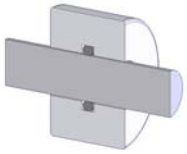

DESIGN CHART #5 - ROTATING SHAFT SEAL

PAI Size	Shaft Size	O-Ring ID	O-Ring Cross Section	Actual Shaft Diameter +. 0000	Groove Root Diameter -.000 +.002	Groove Width ±.003	Bearing Length	Radial Clearance Max	Bearing ID Tolerance -.0000
1-007	1/8	.145 ±.005	.070 ± .003	.125 -.001	.256	.080	5/8	.0008 -.001	+.0008
1-008	5/32	.176 ±.005	.070 ± .003	.156 -.001	.287	.080	5/8	.0008 -.001	+.0008
1-009	3/16	.208 ±.005	.070 ± .003	.1875 -.0014	.318	.080	5/8	.0008 -.001	+.0008
1-010	7/32	.239 ±.005	.070 ± .003	.2187 -.0014	.349	.080	5/8	.0008 -.001	+.0008
70-270	1/4	.270 ±.005	.070 ± .003	.2500 -.0014	.381	.080	5/8	.0008 -.001	+.0008
1-011	9/32	.301 ±.005	.070 ± .003	.2812 -.0014	.413	.080	5/8	.0008 -.001	+.0008
1-110	5/16	.362 ±.005	.103 ± .003	.3125 -.0015	.509	.117	7/8	.0010 -.0015	+.0010
1-111	3/8	.424 ±.005	.103 ± .003	.375 -.0015	.572	.117	7/8	.0010 -.0015	+.0010
1-112	7/16	.487 ±.005	.103 ± .003	.4375 -.0015	.634	.117	7/8	.0010 -.0015	+.0010
1-113	1/2	.549 ±.005	.103 ± .003	.500 -.002	.696	.117	7/8	.0010 -.0015	+.0010
1-114	9/16	.612 ±.005	.103 ± .003	.562 -.002	.758	.117	7/8	.0010 -.0015	+.0010
1-115	5/8	.674 ±.005	.103 ± .003	.625 -.002	.821	.117	7/8	.0010 -.0015	+.0010
1-116	11/16	.737 ±.005	.103 ± .003	.687 -.002	.883	.117	7/8	.0010 -.0015	+.0010
1-211	3/4	.796 ±.006	.139 ± .004	.750 -.002	1.016	.157	7/8	.0015 -.002	+.0012
1-212	13/16	859 ±.006	.139 ± .004	.812 -.002	1.078	.157	7/8	.0015 -.002	+.0012
1-213	7/8	.921 ±.006	.139 ± .004	.875 -.002	1.141	.157	7/8	.0015 -.002	+.0012
1-214	15/16	.984 ±.006	.139 ± .004	.937 -.002	1.203	.157	7/8	.0015 -.002	+.0012
1-215	1	1.046 ±.006	.139 ± .004	1.000 -.002	1.265	.157	7/8	.0015 -.002	+.0012
1-216	1 1/16	1.109 ±.006	.139 ± .004	1.063 -.002	1.329	.157	7/8	.0015 -.002	+.0012
1-217	1 1/8	1.171 ±.006	.139 ± .004	1.125 -.002	1.391	.157	7/8	.0015 -.002	+.0012
1-218	1 3/16	1.234 ±.006	.139 ± .004	1.188 -.002	1.454	.157	7/8	.0015 -.002	+.0012
1-219	1 1/4	1.296 ±.006	.139 ± .004	1.250 -.002	1.516	.157	7/8	.0015 -.002	+.0012

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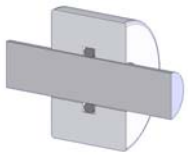

DESIGN CHART #6 - DIAMETRAL CLEARANCE VS. DUROMETER HARDNESS

Shore A Durometer Hardness	Maximum Psi	O-Ring Cross Section .056 .064	.070 .078	.082 .087	.097 .103	.116 .118	.139	.210	.275
60	250	.006	.007	.008	.009	.010	.011	.012	.014
	500	.004	.005	.006	.007	.008	.009	.010	.012
	1000	.003	.004	.004	.005	.005	.006	.007	.008
	1500	.002	.002	.002	.003	.003	.004	.005	.006
70	500	.007	.008	.009	.010	.011	.012	.014	.016
	1000	.005	.006	.006	.007	.008	.009	.010	.012
	1500	.003	.004	.004	.005	.005	.006	.007	.008
	2000	.002	.002	.002	.003	.003	.004	.004	.0045
	2500	.001	.001	.001	.0015	.002	.002	.0025	.0025
80	500	.009	.010	.011	.012	.014	.016	.018	.020
	1000	.007	.008	.009	.010	.011	.012	.014	.016
	1500	.004	.005	.006	.007	.007	.008	.010	.012
	2000	.003	.004	.004	.005	.005	.006	.007	.008
	2500	.002	.003	.003	.004	.004	.005	.006	.007
	3000	.001	.002	.002	.003	.003	.004	.0045	.005
90	500	.012	.014	.015	.016	.017	.018	.020	.020
	1000	.010	.012	.013	.014	.015	.016	.018	.018
	1500	.008	.010	.011	.012	.013	.014	.015	.016
	2000	.006	.008	.008	.009	.009	.010	.012	.016
	2500	.005	.006	.006	.007	.007	.008	.010	.012
	3000	.004	.005	.005	.006	.006	.007	.008	.010
	5000	.002	.003	.003	.004	.004	.005	.006	.006

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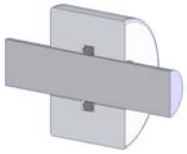

Design Chart #7 - U-Cup Glands

PAI U-Cup Series	Nominal Cross-Section	Groove Depth +/- .003	Groove Width +/-.005	Maximum Piston Clearance
626-0xx	1/16	.062	.093	.002
666-0xx				
626-1xx	3/32	.093	.126	.002
666-1xx				
626-2xx	1/8	.125	.157	.002
666-2xx				
6226-				
626-5xxxx	5/32	.156	.189	.0025
666-5xxxx				
626-3xx	3/16	.187	.219	.0025
666-3xx				
6226-				
626-7xxxx	7/32	.219	.251	.0025
666-7xxxx				
626-4xx	1/4	.250	.282	.0025
666-4xx				
6226-				
626-9xxxx	9/32	.281	.313	.0025
666-9xxxx				
626-10xxxx	5/16	.312	.344	.003
666-10xxxx				
6226-				
626-11xxxx	11/32	.344	.376	.003
666-11xxxx				
626-12xxxx	3/8	.375	.407	.003
666-12xxxx				
6226-				
626-13xxxx	13/32	.406	.438	.003
666-13xxxx				
626-14xxxx	7/16	.437	.470	.003
666-14xxxx				
626-16xxxx	1/2	.500	.532	.003
666-16xxxx				

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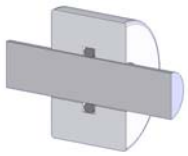

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While both X-Rings and Multiseals® will work well in standard O-Ring grooves, you should get enhanced performance in a customized gland. Due to differences in material finishes, operating pressures, lubricity, and material compatibility, every sealing application is different. The following tables are for designing glands for Static and Reciprocating Dynamic sealing applications. They are intended only as a starting point for the engineer. Each design should be proven in your specific application.

Design Chart #8 - X-Ring Glands

PAI Size Number Range	4444-004 thru -042	4444-102 thru-159	4444-201 thru –265	4444-312 thru -352	4444-433 thru -451
X-Ring Cross Section	.070 ±.003	.103 ±.003	.139 ±.004	.210 ±.005	.275 ±.006
Dynamic Seal					
Groove Depth	.062 -.002	.093 -.002	.126 -.002	.190 -.002	.254 -.002
Groove Width (wall to wall)	.080 ±.003	.117 ±.003	.157 ±.005	.237 ±.005	.310 ±.005
Static Seal					
Groove Depth	.057 -.002	.089 -.002	.120 -.002	.195 -.002	.250 -.002
Groove Width (wall to wall)	.080 ±.003	.117 ±.003	.157 ±.005	.237 ±.005	.310 ±.005
Diametric Clearance (max.)	.002	.003	.003	.004	.005
Radius (max.)	.010	.010	.015	.015	.015
Eccentricity (max)	.002	.002	.003	.004	.005

Design Chart #9 - Multiseal® Glands

PAI Size Number Range	4-006 thru 4-044	4-109 thru 4-166	4-204 thru 4-270	4-324 thru 4-369	4-425 thru 4-453
Multiseal Cross Section	.070 ±.003	.103 ±.003	.139 ±.004	.210 ±.005	.275 ±.006
Piston Groove					
Groove Depth	.055 -.002	.091 -.002	.126 -.002	.191 -.002	.245 -.002
Groove Width (wall to wall)	.080 ±.003	.117 ±.003	.175 ±.005	.255 ±.005	.295 ±.005
Housing Groove					
Groove Depth	.057 -.002	.093 -.002	.129 -.002	.195 -.002	.250 -.002
Groove Width (wall to wall)	.080 ±.003	.117 ±.003	.175 ±.005	.255 ±.005	.295 ±.005
Rotating Seal (Housing Only)					
Groove Depth	.057 -.002	.093 -.002	.129 -.002	.195 -.002	.250 -.002
Groove Width (wall to wall)	.075 ±.003	.115 ±.003	.168 ±.005	.247 ±.005	.285 ±.005
Diametric Clearance (max.)	.002	.003	.003	.004	.005
Radius (max.)	.010	.010	.015	.015	.015
Eccentricity (max.)	.002	.002	.003	.004	.005

The Gland dimensions provided are only intended to be a starting point for your design. We recommend that you test each application to meet your requirements.

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